

NON-PUBLIC?: N
ACCESSION #: 8903090386
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Wolf Creek Generating Station PAGE: 1 of 6

DOCKET NUMBER: 05000482

TITLE: Loose Terminal Connections Cause Main Steam Isolation Valve Closure
Resulting In Reactor Trip
EVENT DATE: 02/02/89 LER #: 89-004-00 REPORT DATE: 03/01/89

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Merlin G. Williams - Manager Plant Support TELEPHONE #: 316-364-8831

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On February 2, 1989, at approximately 1321 CST, a Reactor trip occurred from 100 percent power as a result of Steam Generator (S/G) 'C' reaching the lo-lo level trip setpoint following closure of S/G 'C' Main Steam Isolation Valve (MSIV 'C'). In addition, a Feedwater Isolation Signal, an Auxiliary Feedwater Actuation Signal, and a Steam Generator Blowdown and Sample Isolation Signal actuations occurred as designed.

The cause of the Reactor trip has been determined to be a loose screw on a terminal strip in the Solid State Protection System (SSPS). During unrelated maintenance, this loose termination was bumped resulting in a fast close signal to MSIV 'C'. Efforts to identify the root cause of the loose terminal connections have been unsuccessful. Other terminations in the SSPS and other control room process cabinets were checked and tightened as necessary. In order to prevent recurrence of this event, a check of screws in these applications will be added to the Instrumentation and Controls preventative maintenance program.

(End of Abstract)

TEXT: PAGE: 2 of 6

INTRODUCTION

On February 2, 1989, at approximately 1321 CST, a Reactor (AB-RCT) trip occurred from 100 percent power as a result of Steam Generator (S/G) 'C' (AB-SG) reaching the lo-lo level trip setpoint following closure of S/G 'C' Main Steam Isolation Valve (MSIV 'C') (SB-ISV). In addition, a Feedwater Isolation Signal (FWIS), an Auxiliary Feedwater Actuation Signal (AFAS), and a Steam Generator Blowdown and Sample Isolation Signal (SGBSIS) actuations occurred as designed. The required safety related equipment performed as designed. This event is being reported pursuant 10CFR50.73(a)(2)(iv) as automatic actuations of Engineered Safety Features (ESF) (JE) equipment.

DESCRIPTION OF EVENTS

Prior to the trip, the unit was in Mode 1, Power Operation, at 100 percent power, with the Reactor Coolant System (RCS) (AB) at normal operating temperature and pressure. Feedwater flow was being provided by Main Feedwater Pumps (MFP) 'A' and 'B' (SJ-P) in automatic control. Each Main Feedwater Control Valve (SJ-FCV) was open and in automatic control.

On February 2, 1989, at approximately 1321 CST, a Reactor trip occurred from 100 percent power, when S/G 'C' reached the lo-lo level setpoint. In addition, FWIS, AFAS, and SGBSIS actuations occurred. Two S/G 'C' Main Steam Safety Valves (MSSV), ABV-75 and ABV-76 (SB-RV), opened as verified by visual observation and chart recorder traces. The S/G Power Operated Relief Valves (PORV) (SB-RV) also opened as expected. Control Room (NA) operators performed the appropriate Emergency Operating Procedures and stabilized plant conditions. Proper functioning of safety equipment was verified.

By 1339 CST, the affected equipment was re-aligned to normal configuration, with the exception of the S/G 'C' MSSV ABV-75, which appeared to have a minor leak based on visual observation and tailpipe temperatures, and Control Room operators exited the Emergency Operating Procedures.

Immediately following the event, it was discovered that at approximately 1321 CST, an Instrumentation and Controls (I&C) technician was performing unrelated maintenance which required placing a jumper across terminal board TB614 (JE-ECBD) located inside Solid State Protection System (SSPS) cabinet SB029C (JE-CAB). It is believed that while placing the jumper across terminal board TB614, the I&C technician may have bumped the plastic cable raceways housing the wiring for the logic circuitry of the MSIV 'C'.

TEXT: PAGE: 3 of 6

Initial investigations following the Reactor trip found the screws on the terminal board connections (JE-CON) associated with the fast closure circuitry for each S/G MSIV loose on terminal board TB626 internal to SSPS

cabinet SB029C. These particular connections are associated with the fast closure Engineered Safety Features Actuation System (ESFAS) (JE) signals which are "open to trip" configurations. Specifically, these connections were loose enough to cause an open circuit if disturbed. This was proved during the event recreation performed in conjunction with the MSIV 'C' troubleshooting activities. The loose connection resulted in a fast closure signal in the Red Train (active side) of the MSIV actuator. The redundant Yellow Train (standby side) was not activated. This resulted in a single train of the accumulator (AB-ACC) actuating MSIV 'C'.

MSIV CLOSURE

Initial Control Room indication led to the belief that MSIV 'C' had not fully closed following receipt of the fast closure signal. Operations personnel were dispatched to the scene.

Approximately three minutes after the Reactor trip, an off-watch Senior Reactor Operator arrived in the Control Room and rechecked the indication for MSIV 'C'. Upon wiggling the indicator, the light illuminated resulting in satisfactory closed indication. He also noted that the open indication light was extinguished when he arrived in the Control Room. For this light to be extinguished, the closed limit switch (AB-33) must be actuated.

Approximately 13 minutes after the Reactor trip, Operations and Maintenance personnel who had been dispatched to the scene reported that the closed limit switch for MSIV 'C' had made contact; however, the valve was observed to be slowly closing.

As a result of this observation, an investigation and troubleshooting effort was initiated. Initial troubleshooting efforts centered around considerations that the associated MSIV accumulator might not have been fully charged and therefore, had exhausted itself of volume before MSIV 'C' had fully closed. In an effort to duplicate the observed results, the accumulator was allowed to recharge and a fast closure signal was initiated by lifting the same lead that had previously caused an open circuit. The MSIV was observed both locally and from the Control Room indication to fast close normally in approximately 2.5 seconds.

TEXT: PAGE: 4 of 6

A review of the sequence of events computer printout indicated that the closed limit switch on MSIV 'C' picked up approximately 20 seconds after the initiation of the event (i.e. generation of the fast closure signal). The sequence of events computer printout further indicated that MSIV 'C' did fast close, as demonstrated by the physical sequence of events observed (i.e. increasing S/G 'C' pressure, decreasing S/G 'C' level due to shrink,

etc.). A slow closure would not have produced these results in the time frame indicated.

Comparisons of the plant parameters were made with a previous 100 percent Safety Injection (SI) in which MSIV closure occurred. The plant parameters during the Reactor trip, including the S/G parameters, behaved in a very similar manner as those indicated during the previous SI event. During the SI event with both accumulators for each MSIV having discharged, the MSIVs indicated closure time was approximately 2.5 seconds. The results of this comparison provided additional assurance that MSIV 'C' closed in the required time.

A review of the logic circuitry identified that the initiating event resulted in a fast closure signal being generated and locked in. The fast closure signal remained locked in throughout the Reactor trip. This signal is not removed without operator actions and these actions were not taken.

Discussions were held with the MSIV vendor (Anchor Darling) concerning the observed MSIV 'C' motion reported approximately 13 minutes after the Reactor trip. The vendor stated that the MSIV stem motion is approximately 20 seconds per inch in slow close mode. The personnel did not arrive on the scene until 13 minutes after the event initiation. Slow closure full stroke time is approximately 8 minutes. Therefore, it is doubtful that what the personnel observed was valve slow closure; but rather the stem pulsation caused by valve actuator accumulator air-oil pump (AB-P) strokes. Subsequent discussions were held with the Operations and Maintenance personnel who had observed the valve slowly closing. As a result of these discussions it was agreed that the valve could have been pulsating rather than slowly closing. From their observations, they could not be certain.

Final discussions with the vendor concerned the indicated 20 second closure time. These discussions centered on the setting of the full closed limit switch being too demanding. All other physical checks of this valve operation indicate that the valve did fast close but failed to develop the closed indication.

TEXT: PAGE: 5 of 6

The Plant Safety Review Committee (PSRC) reviewed the information on the MSIV closure prior to restart of the unit. The PSRC concurred that the valve did operate properly on the fast closure signal resulting in the Reactor trip.

ROOT CAUSE AND CORRECTIVE ACTIONS

The cause of the Reactor trip has been determined to be a loose screw on a

terminal strip in the SSPS. Efforts to identify the root cause of the loose terminal connections have been unsuccessful.

Subsequently, the MSIV connections were tightened and the potential for common-mode failure was considered. As a result, I&C personnel inspected and tightened as necessary, all SSPS Train 'A' and Train 'B' terminal board connections. This effort was expanded to include all vendor connections on the individual slave relays (JE-RLY) located in these cabinets, the Balance of Plant (BOP) ESFAS cabinets (JE-CAB), and the majority of the Control Room cabinets (NA-CAB), including the Process/Control cabinets (JG-CAB), the Reactor Trip Breaker Cubicles (JD-PL), and the Main Control Boards (NA-MCBD).

Estimates of the number of loose connections versus the actual population indicate that the number of loose connections (greater than one-half turn loose) was actually less than one percent, and of this number, the majority were located at the vendor terminations local to the slave relays. It was noted that even though the terminations in the SSPS were found loose, the SSPS functions have been tested on a regular basis with no failures attributable to loose connections experienced. In order to prevent recurrence of this event, a check of screws in these applications will be added to the I&C preventative maintenance (PM) program. This check will be added to the PM program prior to restart following the next refueling outage.

ADDITIONAL INFORMATION

There was no danger to plant equipment or release of radioactivity as a result of this event. At no time did conditions develop that may have posed a threat to the health or safety of the public.

TEXT: PAGE: 6 of 6

Although Licensee Event Reports (LERs) 85-026-00, 85-051-00, 86-044-00, 87-041-00 and 88-029-00 discuss previous occurrences of ESF equipment actuations caused by accidental bumping or jarring of various components, this event is different from these previous occurrences due to the loose connections. Therefore, the corrective actions taken as a result of these previous occurrences had no effect on this event.

The slight leakage observed on MSSV ABV-75 was reviewed for potential impact on USAR Chapter 15 accident analysis. Based on the slight amount of leakage actually present and an evaluation of leakage consequences, it was determined that operation with the MSSV leakage did not invalidate the USAR safety analysis results and conclusions. The PSRC reviewed this information and unanimously recommended plant restart. This leakage has since stopped.

ATTACHMENT # 1 TO ANO # 8903090386 PAGE: 1 OF 1

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Bart D. Withers
President and
Chief Executive Officer

March 1, 1989

WM 89-0071

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station PL-137
Washington, D. C. 20555

Subject: Docket No. 50-482: Licensee Event Report 89-004-00

Gentlemen:

The attached Licensee Event Report (LER) is submitted pursuant to 10 CFR 50.73 (a) (2) (iv) concerning an Engineered Safety Features actuation.

Very truly yours,

/s/ B. D. WITHERS
Bart D. Withers
President and
Chief Executive Officer

BDW/jad

Attachment

cc: B. L. Bartlett (NRC), w/a
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